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PCT

REC'D 24 JAN 2001

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

| | | |
|--|---|--|
| Applicant's or agent's file reference J00041915WO | FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) | |
| International application No. PCT/IB99/01699 | International filing date (day/month/year) 05/10/1999 | Priority date (day/month/year) 05/10/1998 |
| International Patent Classification (IPC) or national classification and IPC F01L1/24 | | |
| Applicant EATON AUTOMOTIVE S.P.A. et al. | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 8 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

| | |
|---|---|
| Date of submission of the demand 05/05/2000 | Date of completion of this report 19.01.2001 |
| Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 | Authorized officer Vedoato, L Telephone No. +49 89 2399 8053  |

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/IB99/01699

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

Description, pages:

| | | | | |
|------------|---------------------|------------|----------------|------------|
| 1-3,6,7,10 | as originally filed | | | |
| 4,5,8,9 | as received on | 13/11/2000 | with letter of | 09/11/2000 |

Claims, No.:

| | | | | |
|-----------|----------------|------------|----------------|------------|
| 6-12 | as received on | 13/11/2000 | with letter of | 09/11/2000 |
| 1-5,13-22 | as received on | 06/12/2000 | with letter of | 04/12/2000 |

Drawings, sheets:

| | | | | |
|-----------------|---------------------|------------|----------------|------------|
| 1/7-3/7,5/7-7/7 | as originally filed | | | |
| 4/7 | as received on | 13/11/2000 | with letter of | 09/11/2000 |

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/IB99/01699

listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☒ the claims, Nos.: 23-26
☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | |
|-------------------------------|------------------|
| Novelty (N) | Yes: Claims 1-22 |
| | No: Claims |
| Inventive step (IS) | Yes: Claims 1-22 |
| | No: Claims |
| Industrial applicability (IA) | Yes: Claims 1-22 |
| | No: Claims |

2. Citations and explanations
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/IB99/01699

Section V - Novelty, Inventive Step and Industrial Applicability

The nearest prior art is shown in D4.

The cited document shows a valve train assembly having most of the features described in claim 1.

The valve train assembly described in claim 1 differs from the one shown in the closest prior art because it is manufactured and then pre-assembled separately from an internal combustion engine, while in D4 the cylinder 2 and the cam holder block 15 have to be mounted together in order to machine the bearing hole 17, then the two parts have to be separated so that the camshaft and rocker arms can be fitted before re-assembly.

Same arguments apply to claim 18.

Since none of the documents cited in the search report show or suggest any of the above mentioned features, the subject matter of claims 1 and 18 can be considered to meet the requirements listed in Article 35(2) PCT.

The dependent claims 2-17 and 19-22 also meet these requirements by virtue of their dependency.

Industrial applicability is obviously given.

Arrangements embodying the invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a side view of a prior art rocker arm;

Fig. 2 is a side view, partly in section, of a rocker arm arrangement
5 according to the invention applied to a valve;

Fig. 3 is a side view of the rocker arm of Figure 2;

Fig. 4 is a plan view of the rocker arm shown in Fig. 3;

Fig. 5 is a section along the line V-V of Fig. 3;

Fig. 6 shows is a section along the line VI-VI in Fig. 3;

10 Fig. 7 is a section through a hydraulic tappet forming a fulcrum of the rocker arm;

Fig. 8 is a transverse section showing a valve train carrier of the present invention, for controlling two rows of valves with a single central camshaft;

15 Fig. 9 is a plan view of the valve train carrier as shown in Fig. 7;

Fig. 10 is a side view showing another embodiment of a valve train assembly in accordance with the invention; and

Fig. 11 is a perspective view, from below, of a valve train carrier of the assembly of Fig. 10.

20 Fig. 1 shows a prior art rocker (B') made of pressed aluminium, and comprising a lever of the first order mounted on a fixed axle (70), which also carries other rockers arranged in a row. One end of the rocker (B') is in

contact with a cam (C) by means of a roller (R'), while the other end has a reciprocating and pivoting hydraulic lash adjuster, referred to also as a tappet (80). The tappet has a spigot or projection (81) at the base acting on the head of a valve (V). A double row of camshafts (A') acts on convex surfaces of rollers (R').

Fig. 2 shows an example of a rocker arm arrangement according to the present invention.

The rocker (B) of the present invention is again a lever of the first order, i.e. it is a centre-pivoted rocker arm. However, the rocker (B) is mounted on a tappet (4) placed between a first end of the rocker (B), which is fitted with a roller (R) displaced and pushed against a cam (C) on the camshaft, and a second end, which transmits the pressure to open the poppet valve (V) against the resilient force of a spring (M).

The rocker (B) shown in Figs. 3 to 6 is made up of two lateral flanges (12) and (12'), linked by an upper plate (13), with which it forms a U-shaped section, and is formed by bending or stamping a sheet of steel.

In the process of pressing the rocker from sheet steel, a hemispherical recess (14) is formed in the plate (13), suitable for mating with the hemispherical head (41) of a spigot or projection (42) which is part of a lash adjuster or tappet (4). The tappet (4) is fitted in its own fixed seat (45, Fig. 7) formed by boring an aluminium cover (L) of the engine head. The cover (L) constitutes a valve train carrier, and is discussed further below.

resilient enlarged portion which engages in an annular ridge within the recess. In any event, it is desired that the means attaching the rocker arm to the fulcrum be fairly loose, and arranged so as not to inhibit the intended operational movement of the rocker arm.

5 Fig. 7 is a detailed view of the tappet (4), which keeps rocker (B) pressed against one end of the valve head (V) by means of the pivoting trunnion (16), and at the other end against the cam (C) by means of roller (R). The spigot (42), carrying the hemispherical head (41) which forms the rocker fulcrum, forms a plunger which is attached to a chamber (43) which slides in a
10 sleeve (44) inserted precisely into the seat (45) formed by boring in the cover (L) of the engine block. Within the lower part of the chamber (43) is a high pressure tappet chamber (47), whilst above is a plunger (48) which houses a low-pressure oil reservoir (49). The oil is supplied through the inlet (50) and channels (51) in the cover (L).

15 Inlets (46) and (46') are provided in the spigot (42) for the purpose of lubricating the hemispherical end (41) which acts as the fulcrum.

By way of example, Figs. 8 and 9 show from the side and from above, respectively, the arrangement of a valve control train using rockers (B1), (B2), ... as described above, for operating valves V1, V2, ... in an internal
20 combustion engine with a single central camshaft (A).

Using such an arrangement facilitates the assembly of an engine. The engine cylinder head has a lower head part (65) into which the valves (V1)

and (V2) are installed. Their springs (M) are located in recesses (60) of the lower head (65).

In a separate operation, the valve train carrier formed by the cover (L) has fitted thereto the rocker arms (B1) and (B2), together with any other
5 rocker arms required for the engine (see Fig. 9). This therefore forms a self-supporting assembly which can be manufactured and sold separately from the rest of the engine and provided in a pre-assembled state ready for fitting to the engine. Thus, not only is the overall assembly facilitated by pre-assembling the valve carrier, but the individual fitting of the rocker arms can be carried
10 out as a separate operation, so the final assembly of the engine is significantly simpler.

If desired, a manufacturer can supply different versions of the valve carrier, all for fitting to the same engine head, but made to different specifications. For example, one version may have hydraulic lash adjusters
15 and rocker arms provided with rollers, and another, less-expensive one may have mechanical lash adjusters and a fixed cam-engaging surface on the rocker arms rather than rollers. This facilitates the production of different types of engines, suited to the customer, while still enabling a simple assembly procedure.

20 The location of the respective fulcra on the cover (L) can be selected such that all the rocker arms may have the same length, and therefore can if desired be constructed identically.

CLAIMS:

1. A valve train assembly comprising:

a valve train carrier having a plurality of individual rocker arm fulcra;

and

5 a plurality of rocker arms, each rocker arm being attached to a respective fulcrum and being pivotable about the fulcrum;

characterised in that the assembly has been manufactured and then pre-assembled separately from, but is operatively attachable to, an internal combustion engine such that the rocker arms are movable by cams in order to
10 operate valves of the engine.

2. An assembly as claimed in claim 1, wherein each fulcrum forms part of a lash adjuster.

15 3. An assembly as claimed in claim 2, wherein each lash adjuster is an hydraulic lash adjuster.

4. An assembly as claimed in any preceding claim, wherein each rocker arm constitutes a lever of the first order.

20

5. An assembly as claimed in any preceding claim, wherein each rocker arm has a part-spherical surface for mating with a corresponding surface of the fulcrum to which it is attached.

13. An assembly as claimed in any preceding claim, the assembly also having mounted thereto at least one camshaft.

14. An assembly as claimed in any preceding claim, the carrier
5 having formed therein channels for conveying oil to the fulcra.

15. An assembly as claimed in any preceding claim, wherein each rocker arm carries a roller for engagement with a cam of a camshaft, and wherein each roller has a substantially flat cylindrical outer surface.
10

16. An assembly as claimed in any preceding claim, the carrier supporting rocker arms for inlet and exhaust valves for a plurality of cylinders.

17. An internal combustion engine having a valve train assembly
15 as claimed in any preceding claim, the engine comprising a plurality of cylinders each having inlet and exhaust valves, said carrier supporting rocker arms for said inlet and exhaust valves.

18. A method of assembling an internal combustion engine, the
20 method comprising:

(a) providing a valve train assembly which has been manufactured and pre-assembled separately from the internal combustion engine, the providing step comprising:

(i) providing a valve train carrier having a plurality of individual rocker arm fulcra; and

(ii) attaching a rocker arm to each fulcrum;

and

5 (b) mounting the carrier with the attached rocker arm on a cylinder head of the internal combustion engine such that each rocker arm is brought into functional relationship with a respective engine valve.

10 19. A method as claimed in claim 18, the method including the step of mounting at least one camshaft to the carrier before mounting the carrier on the cylinder head.

15 20. A method as claimed in claim 18 or claim 19, wherein each rocker arm is mounted to a respective fulcrum by means of an apertured sheet which is snapped-fitted over the fulcrum.

21. A method as claimed in any one of claims 18 to 20 including forming each rocker arm by deformation of a sheet.

20 22. A method as claimed in claim 21, including forming a part-spherical surface on each rocker arm by deformation of said sheet for mating with a corresponding part of a fulcrum.

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FIG. 8

